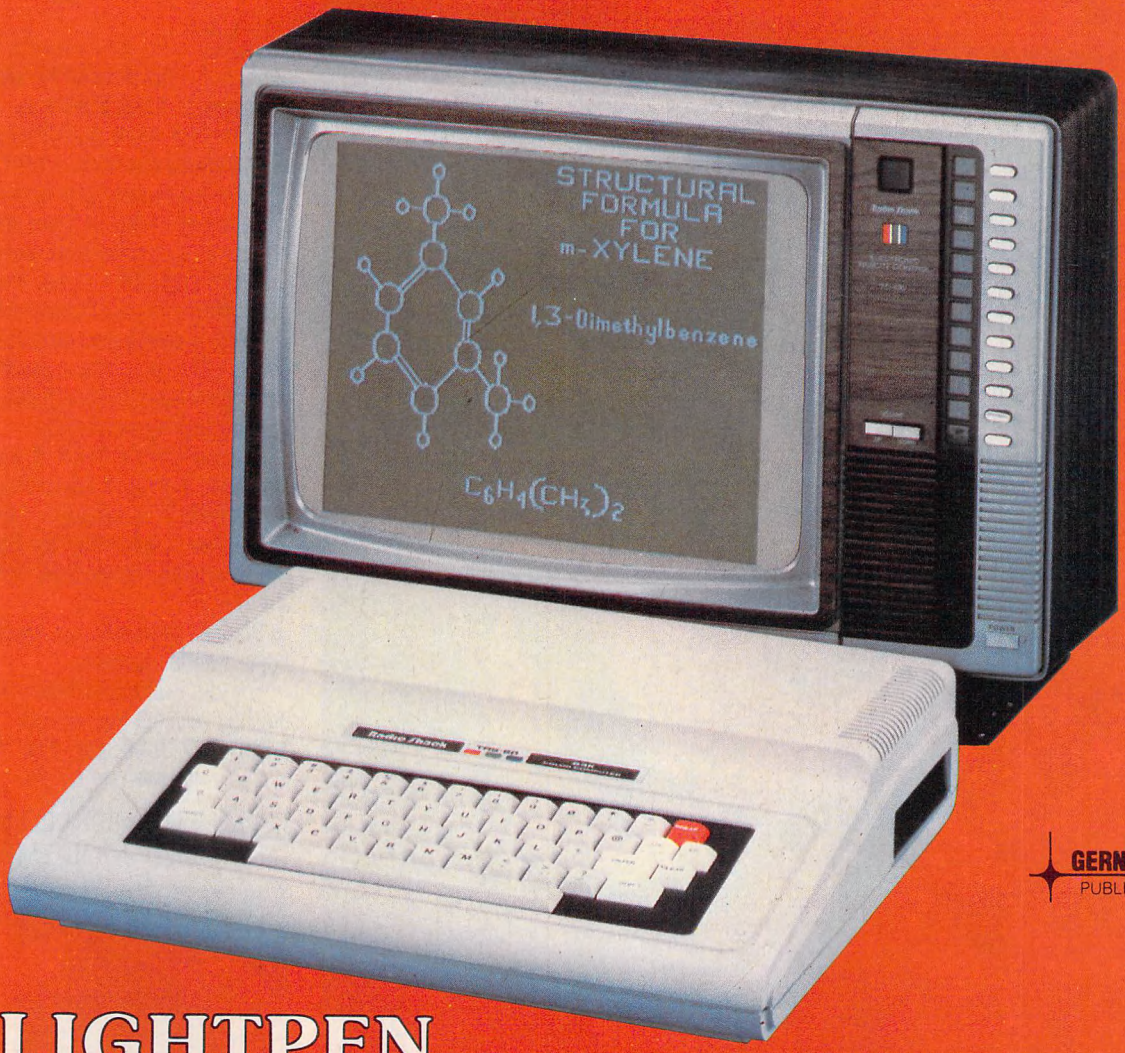
VOL. 2 No. 6 June 1985

COMPUTER DIGEST

NEW KIND OF MAGAZINE FOR ELECTRONICS PROFESSIONALS



A GERNSBACK PUBLICATION

LIGHTPEN FOR YOUR COMMODORE

Make your 64 more versatile.

UPGRADE THE COCO

That color computer you bought for playing games can be retrofitted to use for serious business applications.

Take home a world champion.

$85* gets you a technical knockout. **The Fluke 70 Series. Winners of the digital vs. analog battle.**

Since their debut, they've become the worldwide champions of the industry.

Never before have such tough, American-made meters offered so many professional features at such unbeatable prices.

Each comes with a 3-year warranty, 2,000+ hour battery life, and instant autoranging.

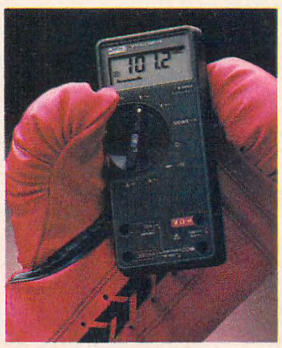
You also get the extra resolution of a 3200-count LCD display, plus a responsive analog bar graph for quick visual checks of continuity, peaking, nulling and trends.

Choose from the Fluke 73, the ultimate in simplicity. The feature-packed Fluke 75. Or the deluxe Fluke 77, with its own protective holster and unique "Touch Hold" function** that captures and holds readings, then beeps to alert you.

So don't settle for just a contender. Take home a world champion.

For your nearest distributor or a free brochure, call toll-free anytime **1-800-227-3800, Ext. 229.** From outside the U.S., call 1-402-496-1350, Ext. 229.

FROM THE WORLD LEADER IN DIGITAL MULTIMETERS.



FLUKE 73	FLUKE 75	FLUKE 77
$85*	$99*	$129*
Analog/digital display	Analog/digital display	Analog/digital display
Volts, ohms, 10A, diode test	Volts, ohms, 10A, mA, diode test	Volts, ohms, 10A, mA diode test
Autorange	Audible continuity	Audible continuity
0.7% basic dc accuracy	Autorange/range hold	"Touch Hold" function
2000+ hour battery life	0.5% basic dc accuracy	Autorange/range hold
3-year warranty	2000+ hour battery life	0.3% basic dc accuracy
	3-year warranty	2000+ hour battery life
		3-year warranty
		Multipurpose holster

* Suggested U.S. list price, effective July 1, 1984.
** Patent pending.

FLUKE®

Copyright © 1984, John Fluke Mfg. Co., Inc. All rights reserved. Ad No. 4701-70

CIRCLE 259 ON FREE INFORMATION CARD

CONTENTS

Vol. 2 No. 6 June 1985

8 Upgrading the CoCo and 64
Here's how to retrofit that computer you bought for game-playing so it can get down to some serious work in business. **Herb Friedman**

12 Build A Light Pen for the Commodore 64
This simple one-evening project will provide added versatility for your computer. **Jim Stephens**

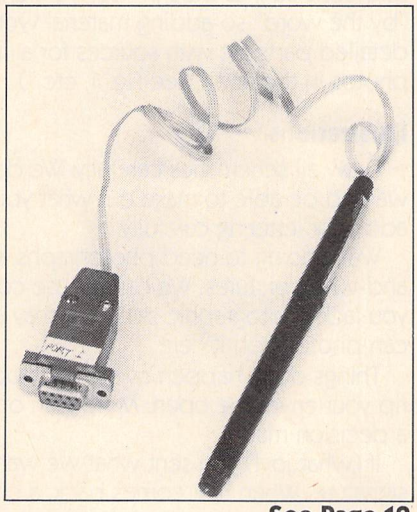
4 Editorial

5 Letters

5 Computer Products

16 Software Review

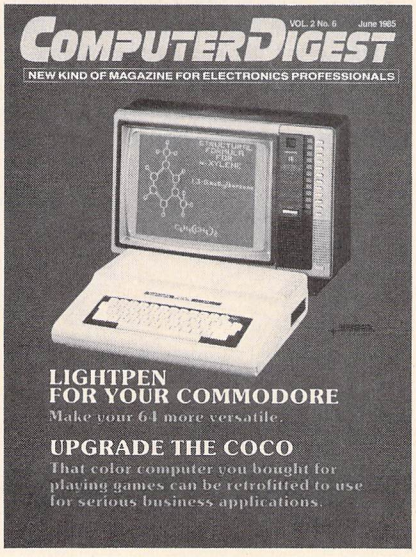
See Page 8



See Page 12

ON THE COVER

The Radio Shack Color Computer, familiarly known as the "CoCo" gets the full treatment and rolls up its sleeves for some real business and scientific applications. Cover photo Courtesy of Radio Shack, A Division of Tandy Corporation. **See page 7.**


VOL. 2 No. 6 June 1985
COMPUTERDIGEST
NEW KIND OF MAGAZINE FOR ELECTRONICS PROFESSIONALS
LIGHTPEN
FOR YOUR COMMODORE
Make your 64 more versatile.
UPGRADE THE COCO
That color computer you bought for playing games can be retrofitted to use for serious business applications.

EDITORIAL

Here's how to get started as an author!

■Surely, you've got a pet project that you looked at and said "Hey! that would make a great article for **ComputerDigest!** You might be right.

You write a letter to the Editor, telling what the project is, how well it works, why our readers will want to see it, and what it's all about. If we think it's interesting, you'll get a letter asking you to go ahead with the project.

Now you're going to write about your project. Start at the beginning, telling our readers why you needed it, how you constructed it, and how it works. Since the **ComputerDigest** reader is knowledgeable, you can go into detail. Explain how to connect it into the system, test it, and use it.

When you're writing about it, write to *express*, not to *impress*. Don't worry about using "big words" or flowery language. Say what has to be said concisely, as though you were explaining it to a friend. We do not pay "by the word" so adding material won't enhance your income. Include a detailed parts list with sources for all parts used. Reference all art and photos in the text ("See Fig. 1, etc.")

Illustrations

Draw all schematics carefully. We don't expect finished artwork, but we want to be able to make out what you're trying to show. Use a ruler and add your lettering carefully.

We're going to need photographs. Good, clear, contrasty, sharp, black-and-white pictures. We cannot use color photos in any form whatever. If you lack photographic skills, we may ask you to send the project in so we can photograph it here.

Things don't happen overnight. Nobody is going to drop everything to rip your envelope open. More than one person will review the material, and a decision made.

If (what joy!) you sent what we wanted, a contract will be sent for your signature. When that comes back, a check will be issued by our accounting department, and your article goes into the works.

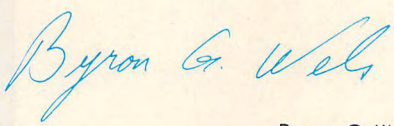
Now what happens?

You open the new issue of **ComputerDigest** and see a familiar project. It's yours, and under the title, is *YOUR NAME!*

Let me tell you something, that makes it all worthwhile.

You won't get rich on the payment you receive. We do pay competitively. It usually works out to about $100 a page. Certainly it's enough to make your effort worthwhile, and while it is your money, we recommend that you take some of it and treat the wife to a good dinner, just to celebrate.

Okay. Now you know how and you know why, so put on your thinking caps, and let us hear from you.◀CD▶



Byron G. Wels
Editor

ComputerDigest is published monthly as an insert in Radio-Electronics magazine by Gernsback Publications, Inc., 200 Park Avenue South, New York, NY 10003. Second-Class Postage Paid at New York, N.Y. and additional mailing offices. All rights reserved. Printed in U.S.A.

A stamped self-addressed envelope must accompany all submitted manuscripts and/or artwork or photographs if their return is desired should they be rejected. We disclaim any responsibility for the loss or damage of manuscripts and/or artwork or photographs while in our possession or otherwise.

COMPUTER DIGEST

Hugo Gernsback (1884-1967)
founder
M. Harvey Gernsback, editor-in-chief
Larry Steckler, CET, publisher
Art Kleiman, editorial director
Byron G. Wels, editor
Brian C. Fenton, technical editor
Carl Laron, associate editor
Robert A. Young, assistant editor
Ruby M. Yee, production manager
Robert A. W. Lowndes, production associate
Dianne Osias, production assistant
Karen Tucker, production assistant
Jacqueline P. Weaver, circulation director
Arline R. Fishman, advertising coordinator

Gernsback Publications, Inc.
200 Park Ave. South
New York, NY 10003
Chairman of the Board:
M. Harvey Gernsback
President: Larry Steckler

ADVERTISING SALES 212-777-6400
Larry Steckler
Publisher

EAST/SOUTHEAST
Stanley Levitan
Radio-Electronics
200 Park Ave. South
New York, NY 10003
212-777-6400

MIDWEST/Texas/Arkansas/Okla.
Ralph Bergen
Radio-Electronics
540 Frontage Road—Suite 325
Northfield, Illinois 60093
312-446-1444

PACIFIC COAST
Mountain States
Marvin Green
Radio-Electronics
15335 Morrison St., Suite 227,
Sherman Oaks, CA 91403
818-986-2001

LETTERS

Air Conditioning?

There's a "computer room" where I work, that's air-conditioned and scrupulously clean, with a raised floor and recessed lighting. I just got a new computer for home, and have none of these refinements. Just how important are they?—J. Sweeney, Stamford, CT.

Not at all. Certainly, they're nice to have, but for the average home computer they aren't at all essential. Where critical material is stored and run, a controlled environment is more important. I wouldn't worry about that, however.

Can Anybody Help?

I own a Timex 1000 and a TVRO Earth Station. I've been looking for a program to plot stationary satellite positions, looking from different parts of the U.S. Is there such a program? Where can it be obtained?—William Scott, Manteca, CA.

Bill, if there is such a program, I'm sure we'll hear from somebody!

The Katt's Meaow

I've been following Marc Stern with great interest. He's one of my favorite authors. —Tager Katt, Framingham, MA.

Thank's, Tager. We like Marc too. In fact, we think he's purrfect!

What's New?

It seems that each time there's a computer show, something radically new is added that you just can't do without. I'm sure that from where you sit, you must get advance notice of what's coming 'round the bend. Can you give us a hint about what to expect in the new computers?—R. D. Carlton, Manassas, VA.

Not really. The manufacturers don't usually like to spill the beans until showtime, and we're kept as much in the dark as you are.

Southern Comfort

Purely as an exercise, I programmed all of the facts regarding the Civil War into my computer, and ran the program, to discover that the South won the war. I proceeded to debug the program for history teaches that the North was victorious. Yet try as I will, I can't find a single glitch, and the South keeps coming up winner. After all these years, can history be in error?—Sam Goodsell, Atlanta, GA.

Sam, I hate to be the one to dash your hopes, but try having a Yankee debug that program for you! (Insert one Rebel Yell.)

Orphans

In shopping around the several computer stores, I frequently see what appears to be a real bargain, and then notice that it's the product of a company that is no longer in business. Is it a safe bet to buy one of these computers? Or am I asking for trouble?—J. P. Sandro, Helena, Mont.

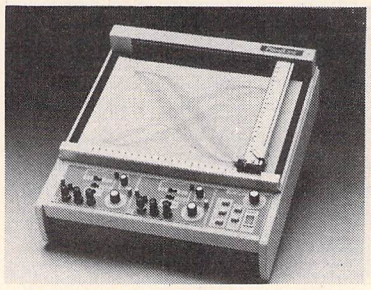
It all depends, J.P. If the store will offer a warranty and will stand behind the equipment, you might make a good deal. Just be sure that they will honor a service contract on the unit and that they have the service facility to back it up.

COMPUTER PRODUCTS

For more details use the free information card inside the back cover

X-Y RECORDERS, model *RW-21T* and model *RW201T,* are precision X-Y recorders that allow recording on two chart sizes.

Features include: electrostatic chart hold with LED chart positioning lights; high pen speed, faster then 1200 mm/second; built-in time sweep (quartz controlled); remote/local penlift; accuracy better than ±0.25% F.S., and 18 switch-selected input ranges from 50μV/cm.

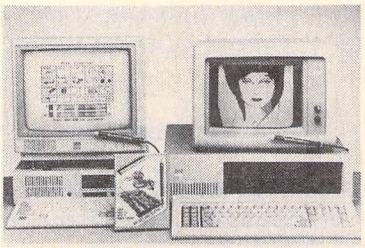


CIRCLE 17 ON FREE INFORMATION CARD

The model *RW-21T* uses DIN A4 format (8½ × 11") and is priced at $1695.00. The model *RW-201T uses DIN A3 (11 × 17"). and is priced at $2395.00.*—**PrimeLine,** PO Box 818, Sun Valley, CA 91353-0818.

LIGHT PEN GRAPHICS PACKAGE, designed for the IBM Personal Computer and the PC*jr,* features the Tech Sketch light pen with fingertip control and a coil-free cord to allow precise

and unrestricted movement. The Micro Illustrator color software included has the ability to store light-pen pictures on diskette and print pictures in color or black-and-white. The artist can select from 10 different brush strokes and 10 different drawing modes, including lines, rays, boxes, circle, color filling, and freehand drawing. Sixteen colors and 16 shades are available. The program will erase mistakes, magnify to provide pixel-by-pixel resolution, store up to 48 screens on diskette, and allow binary storage for hard-copy printing or telephone transmission.



CIRCLE 18 ON FREE INFORMATION CARD

The light pen plugs directly into either computer. A color graphics board is required on the IBM-PC when using Micro Illustrator. No extra equipment is needed for the PC*jr*. The package is priced at under $70, including software.—**Tech Sketch, Inc.,** 26 Just Road, Fairfield, NJ 07006.

UNINTERRUPTIBLE POWER SYSTEM, the Mini-UPS, model *26-00-50750-3800,* is designed to provide up to six times the rated current for very short durations, and is particularly suited for use with small micro and minicomputer systems that require high start-up power for disk drives.

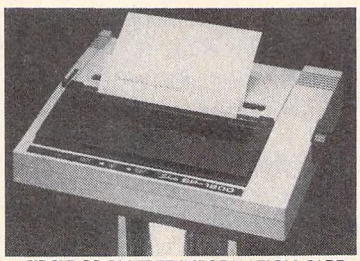
CIRCLE 19 ON FREE INFORMATION CARD

The Mini-UPS always operates between the AC line and the critical load to provide complete protection from all AC power problems that affect small, sensitive electronic equipment— problems including brownouts, blackouts, voltage transients, and electrical line noise.

In the event of a blackout, the unit continues to provide up to 10 minutes of regulated power to the load from its self-contained backup battery. Because the backup battery is always on-line, output continues without interruption. Auxiliary battery packs are available to provide an additional 250 minutes of emergency power. The Mini-UPS is priced at $2178.00.—**Sola Electric,** 1717 Busse Rd., Elk Grove Village, IL 60007.

PRINTER, the model *SP-1200,* features 80-column capacity and has a printing speed of 120 characters per second. This serial dot-matrix printer can provide emphasized and double-print modes, plus superscript/subscript modes. Both single and double-resolution graphic modes are available, as well as logic-seeking printing or incremental printing with high-response stepping motor. Fixed-pitch and proportional-pitch modes are available.

The model *SP-1200* can be used with fanfold, roll, or cut sheet paper, and the head can be replaced without needing any special tool. Included is an 8-language international character



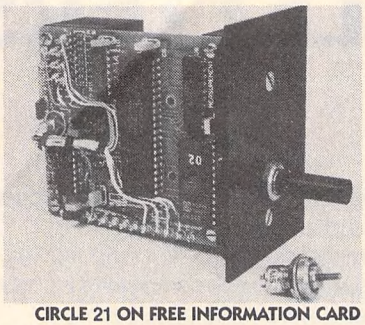
CIRCLE 20 ON FREE INFORMATION CARD

font, including French, Spanish, Italian, Swedish, German, Danish, and English. The characters available include pica and double-width pica, elite and double-width elite, condensed,double-width condensed, and graphic.

The model *SP-1200* is priced at $399.00.—**Sakata U.S.A. Coporation,** 651 Bonnie Lane, Elk Grove, IL 60007.

JOYSTICK CONTROL, model *862,* with serial RS422 output, is designed to yield high performance and easy, compatible interfacing through most serial ports. High performance is achieved by providing a built-in dead band at null and a human-engineered exponential transfer curve that allows the operator to peform single-element positioning and high slew rates with just a small change in the applied force. Compatibile interfacing is made easy by the microprocessor-controlled conversion that can be programmed to meet specific user requirements for either an RS232C or an RS422 port.

The model *862* with serial RS422

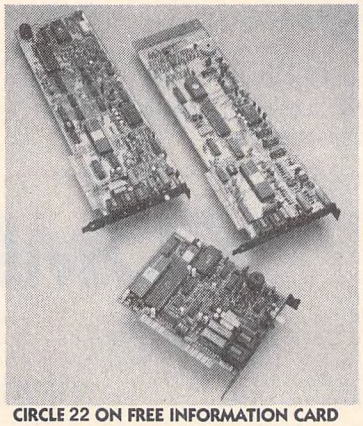


CIRCLE 21 ON FREE INFORMATION CARD

output is priced at $2000.00.—**Measurement Systems, Incorporated,** 121 Water Street, Norwalk, CT 06854.

MODEM SERIES, the Intellimodem model *XL,* model *ST,* and model *XT* are plug-in modem products for the IBM PC/XT/AT. All three modems are 300/1200 baud, auto-answer/auto-dial; include Intellisoft communications software; have unlimited on-line telephone directories and XMODEM protocol file transfer; operate in full or half-duplex, and are 100% Hayes compatible.

The Intellimodem model *XL* operates in dual command role. The user can choose between data transmitted only, using virtually any communication software package written, or use the shared voice and



CIRCLE 22 ON FREE INFORMATION CARD

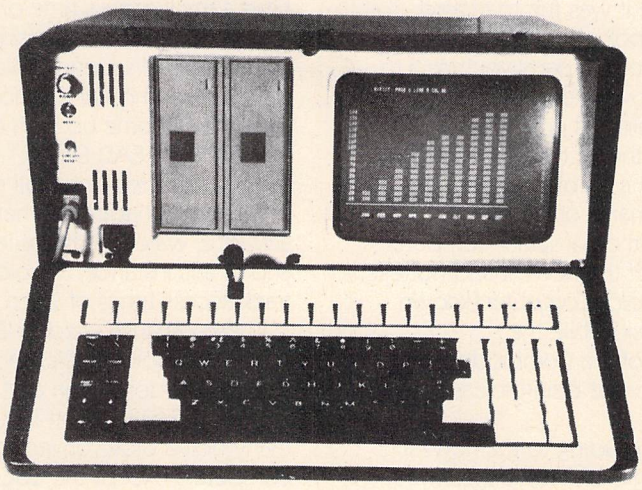
data feature. Voice and data on the same line allows the user to switch between the two with a single keystroke, without having to hang up or redial. It is priced at $549.00.

The Intellimodem model *ST* and model *XT* is for users who don't need the application of shared voice and data. The model *ST* implements the Hayes *Smartmoden 1200* command set precisely. It is priced at $499.00. The model *XT* is a minicard that will fit into all the short slots of the IBM PC/XT. It is priced at $549.00.—**Bizcomp,** 532 Mercury Drive, Sunnyvale, CA 94086.

ZORBA
PORTABLE COMPUTER
THE EXPERTS' CHOICE

FEATURES:

- 9" GREEN OR AMBER CRT
- 19 INDEPENDENT 55 PROGRAMMABLE FUNCTION KEYS
- TWO 400K DSDD DRIVES
- 64K BYTES 200 NS RAM
- C BASIC COMPILER
- IEEE 488 BUS MASTER PORT
- 24.6 LBS
- CPM 2.2 OPERATING SYSTEM
- M80 (L80, LIB80, CREF80)
- SOURCE CODE OF THE BIOS PLUS UTILITIES
- DATA COMMUNICATIONS SETUP PACKAGE
- SERIAL & PARALLEL PRINTER PORT
- DATA COMMUNICATION PORT



OPTIONS:

- 16 BIT 256K RAM UPGRADE (8088 CPU) $600.00
- 800K DSQD 96TPI DRIVES $200.00
- COMPOSITE VIDEO OUTPUT $100.00
- SOFT VINYL CASE $25.00
- TUTOR KIT; $15.00 (CPM, WORDSTAR, CALCSTAR)
- SCHEMATIC SET $10.00
- 10MB HARD DISK DRIVE

VISA/MC

BUNDLED WITH
WORDSTAR, MAIL MERG, SPELLSTAR,
DATA STAR, REPORTSTAR, CALCSTAR

$849.00
W/O Bundle

DEALER INQUIRIES INVITED

$1049.00
With Bundle

General Specifications

ZORBA is the lowest cost full featured portable computer. This light weight computer is ruggedly packaged in a convenient carrying case. The case surrounds a strong inner chassis which further protects the Z80A based computer with its two double sided double density disk 400K drives, large easy to read 9" display screen and well designed detachable keyboard.

ZORBA uses CP/M, the industry standard operating system, which means that a wide range of existing software is readily available to the user.

The ZORBA users manual covers operation of the unit, all supplied software and all interface and internal information. A system diskette is supplied with all system files and utilities. A second diskette contains the sources for all ZORBA software including BIOS, SETUP, FORMAT, and PATCH.

Keyboard

Keyboard communicates serially with CPU
Detachable with 2 foot coiled cord
95 keys in standard QWERTY format
13 Key Numeric pad
Independent Caps Lock and Shift Lock
55 Software programmable function keys
All keys auto-repeat after 1 second delay
All Standard cursor and terminal control keys

Disk System

Controller:	WD1793
Drives:	5.25 Double Sided, Double Density, 400K 48 TPI

Built-in disk interchange formats: Xerox 820 (SD, DD), Kaycomp (DD), DEC VT-180 (SD), Osborne (SD) and IBM-PC (eg. CPM/86) and Televideo 802 (Read/Write and Format compatibility) (Expandable to 61 Formats)

Specifications
General Mechanical and Electrical

Width	-17.5 inches (44.45 cm)
Height	- 9.0 inches (22.86 cm)
Depth	-16.0 inches (40.64 cm)
Weight	-24.6 pounds (11.1 Kg)
Power	-80-130 VAC or 190-245 VAC 50/60 Hz 170 watts max

Display

Display Tube:
9" diagonal, Green or Amber
High resolution display circuitry
60 Hz refresh rate

Display Format:
25 lines x 80 columns
5x7 Character Font with full descenders
128 ASCII Characters
8x9 32 Characters Graphic Font
2K Memory Mapped Display Buffer

CPU Board

Z80A CPU running at 4 Mhz with no wait states
64K bytes of 200 ns RAM (58K after CP/M loaded)
16K bytes of EPROM (2732) can be switched in and out by software
12K available for user EPROMS
8275 CRT controller, DMA driven
1793 Floppy disk controller, SMC data separator
Bipolar proms configure 10 addresses
Fully structured interrupts prioritized by bipolar proms

Interfaces

- Full asynchronous RS232 port with modem control. Baud rates and data translation and protocol programmable
- Full asynchronous full duplex RS232 port with hardware handshake (for printers). Baud rates and protocol programmable. (Serial Printer Port)
- One 8 Bit parallel port with independent strobe and ready lines. Supports Centronics interface with an available adaptor cable.
- IEEE 488 Bus Master Port (ie: General Purpose Instrumentation Bus) not Software Supported.
- 21 Standard Software Programmable Baud Rates: 45.5 to 19,200 BPS

GEMINI ELECTRONICS, INC.
130 Baywood Avenue, Longwood, Florida 32750
305-830-8886 800-327-7182

CIRCLE 262 ON FREE INFORMATION CARD

UPGRADING The CoCo and 64

Getting more from the CoCo and the 64.

HERB FRIEDMAN

■As the software for even the least expensive computers gets more sophisticated, the limitations of the low-cost home-and-family computers becomes even more inconvenient. While it was fun to record your check file on a tape that took a few minutes to load, the spreadsheet analysis of the parts you need to stock for TV and VCR repairs now becomes unweildy and inconvenient, taking five minutes just to load.

And one must not overlook the fact that most of the really good software—let's call it "professional quality"—is now supplied primarily on disk or in cartridge form (depending on the particular computer for which it's intended). Most of the newest and hottest software for the Radio Shack *Color Computer* (known as the CoCo) is supplied on disk, while the inmterminably slow disk drive of the Commodore *64* has resulted in more good software being released in cartridge form.

But there are problems in upgrading to the newest and the best. The cost of a single disk drive system for the CoCo is relatively expensive both for the family and for the service shop, while popping cartridges in and out of a Commodore *64*'s user port doesn't necessarily do the port's connector any good.

Two recently-introduced products however, take care of both problems at reasonable cost, and throw in an extra feature or two that's particularly useful to the programmer and technician.

The devices we're going to cover are the J & M *"CoCo Disk Controller"* —same model for both the Model I and Model 2 CoCos—and the Handic *"Super Box 64"*, a cartridge switcher and IEEE I/O for the Commodore *64*.

Getting it on disk.

Normally, it does not pay to purchase a third-party disk controller and the disk drive separately because the total price is about the same as the latest reduced Radio Shack price; actually lower if you order the Radio Shack disk system from a mail order discounter. But the marketplace is now awash in a sea of obsolete disk drives that can be purchased at rock bottom prices. Fortunately for CoCo users, while the drives might be obsolete for the newest computers, virtually every one is suitable for use with the CoCo.

Okay, this takes some explaining. Early disk drives had a track access time of 25 to 30 milliseconds, which is relatively slow compared to modern drives which have a track access time of nominally 6 milliseconds. Modern software (operating systems) is written to utilize a 6 millisecond drive. If you use 6 millisecond drive, the computer has no idea what's going on. At best, it will come up with an error message such as "DIRECTORY READ ERROR," or the computer will just hang up and require a full reset.

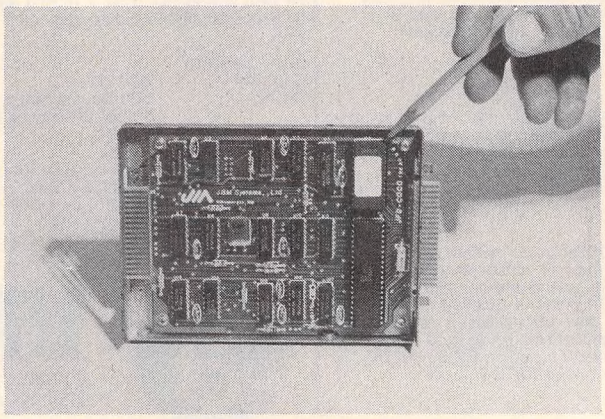
As always happens when there's a technological advance, warehouses are left bulging with the old stuff, and in this instance, the old stuff is disk drives with track access times of 25 to 30 milliseconds.

These can't be used in IBM *PC*'s and *PC* compatible, nor in the Radio Shack *Model 4*: And certainly not in the Commodore, Atari and Apple computers because their disk drives are off in a world of their own. Also, many of the older drives are 35 tracks, and all new computers except the CoCo require 40-track drives.

And so, with the surplus marketplace flooded with obsolete drives, it's possible to purchase a disk drive for the CoCo for as little as $125 (new), under $100 used. Maybe $160 with a power supply and case., or you can build your own power supply from junk-box parts. At these prices it pays to assemble your own disk system using a third-party device such as the J & M *CoCo Disk Controller.*

What's that? You want to know why a 35-track drive with a 30 millisecond track access will work? Because a 35-track drive is much less read-error prone than the 40-track models. So Radio Shack has always provided for a 35-track drive on their budget computers. (It's

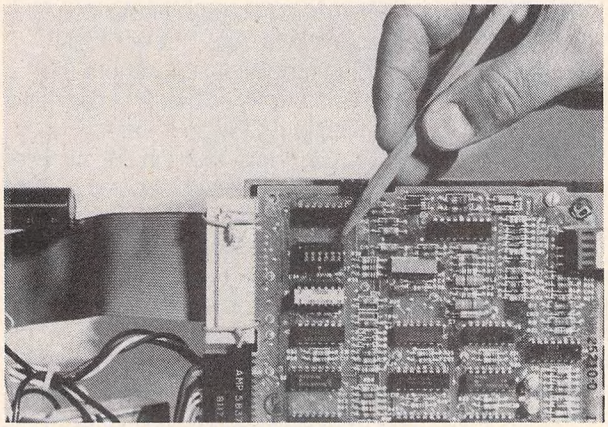
THE J & M SYSTEMS COCO DISK CONTROLLER plugs into the cartridge slot of the Radio Shack Color Computer. It works with either the old or the new models.



PENCIL POINTS TO THE ROM within the controller that contains JDOS Extended Disk Basic.

why their early Model I had less disk drive problems than the later, more sophisticated competition that used 40 track drives.)

While Radio Shack's own disk system is 35 tracks, aftermarket disk controllers such as the J & M provide for 35 or 40 track operation; you specify the number of tracks when you format the disks. If you happen to have a 40-track drive you can use 35 or 40 tracks. The

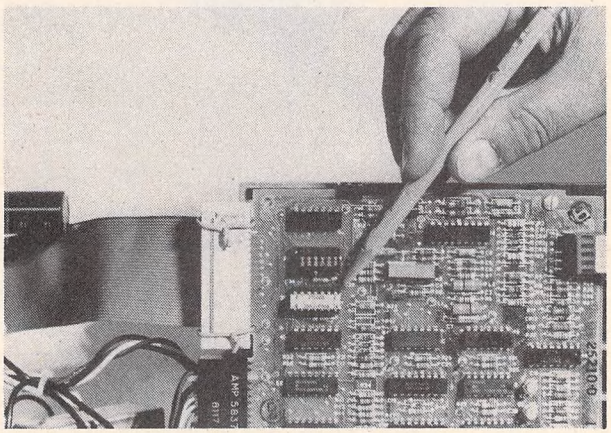


THE DISK DRIVE'S SHUNT BLOCK looks like a DIP IC except for metal straps which shunt the terminals.

computer works just fine with a 35-track drive.

If you want to know what kind of surplus disk drive you're looking for, it must be advertised as TRS-80 compatible, (35 track) or Shuggart 400L (40 track) compatible.

If the drive is advertised as being IBM-*PC* compatible, it is probably a 6 millisecond model and



THE RESISISTOR BLOCK looks just like a DIP IC. It is usually located right next to the shunt block and is often marked with its resistor value.

is perfectly suitable for use with the CoCo. In combination with the J & M Disk Controller the CoCo works with 30 or 6 millisecond drives; in fact, the J & M Disk Controller "comes up" ready for a 6 millisecond drive. The user must specifically initialize the controller for a slower drive by entering the command RATE 3 prior to using the disk system. RATE 3 means a 30 millisecond step rate.

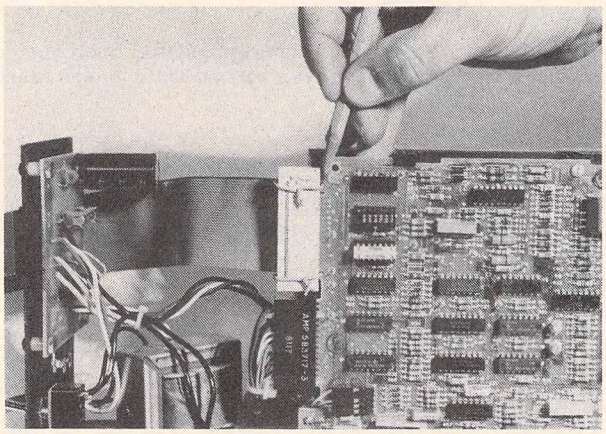
The J & M Controller plugs into the program cartridge port on the right side of the CoCo. In fact, the controller looks like an oversize program cartridge, the only differences being that the cabinet is metal and there are connectors at both ends: One for connection to the CoCo and the other for the cable that connects to the disk drive.

Inside the cabinet are the disk controller and a ROM containing the disk operating system and *Disk BASIC*, *Disk BASIC* being an ovrlay to the CoCo's ROM BASIC which provides the extra functions available through a disk (such as random data files, etc.)

The disk controller has no adjustments of any kind; all you have to do is plug it in and connect the disk drive. If you have any problems it will be in connecting the disk drive. Unlike Radio Shack's own disk controllers which are for the old or new models of the CoCo, the J & M controller works with any version of the CoCo without the need for wiring retrofits or adjustments.

All alike.

Regardless of the kind of disk drive you purchase, if it is TRS-80 compatible it has certain standard features:



IF THE DISK DRIVE'S PRINTED CIRCUIT BOARD has holes drilled opposite the #1 and #33 terminals, pass a length of insulated #20 or #22 solid wire through the holes and around the ribbon connector. A couple of twists secures the wire and the connector.

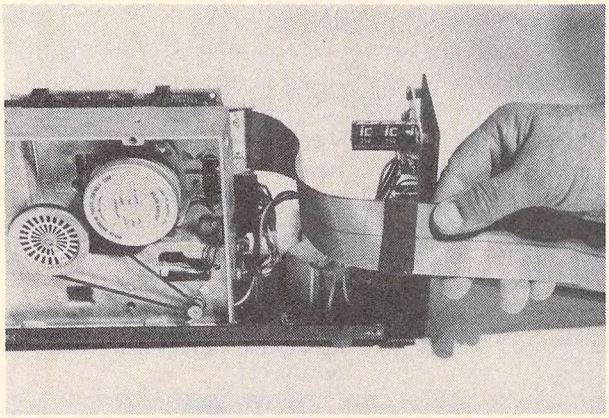
Among them a 34-terminal edge card connector, a DIP socket with shunt straps used to select the drive, and a DIP resistor network that resembles a 14-terminal DIP IC. Everything else about the disk drive's electronics might be different. but these three things are always the same.

The first thing is to set the drive-select connections. Radio Shack normally does this by pulling terminals out of the disk drive connector, which is a good idea if you want to sell a product that can be taken home and put together by an 8-year old. (This was one of the truly great ideas for non-technical users.)

You, as a technician, will program the drive because: a) it is hard to pull a terminal without the proper tool and b) Radio Shack's own cable is unecessarily expensive (assuming you can get one).

The :O drive uses the disk drive's No. 2 Drive Select connection. Locate the DIP socket containing the shunt. The shunt will probably be short one jumper; this is

normal. Though the DIP socket has 14 terminals providing 7 circuits, the jumper is 12 terminals providing 6 circuits. You will use only the top six circuits, those labelled HS, DS1, DS2, DS3, MX, and blank. "Blank" is an unused circuit located between MX and HM. On disk drives intended for the IBM-*PC* the "blank" terminal is labelled "4" for DS4. HM isn't used, you always leave it open. Do not make a mistake and move the shunt device down one step so the top HS terminals are open and the HM terminals are closed.



WRAP TWO TURNS of friction tape around the ribbon wire to protect it where the disk drive's cabinet and the rear panel meet.

To avoid damage, don't attempt to cut through a shunt even though every book tells you to do it with a special tool. (I have never seen this tool sold anywhere!) Instead, remove the shunt block using an IC puller tool and then bend up one pin from the circuits you won't be using.

In the case of the CoCo, DS2—meaning the disk

THE COCO WITH THE DISK DRIVE WHEN COMPLETED. If you want two drives, simply install a second connector on the ribbon.

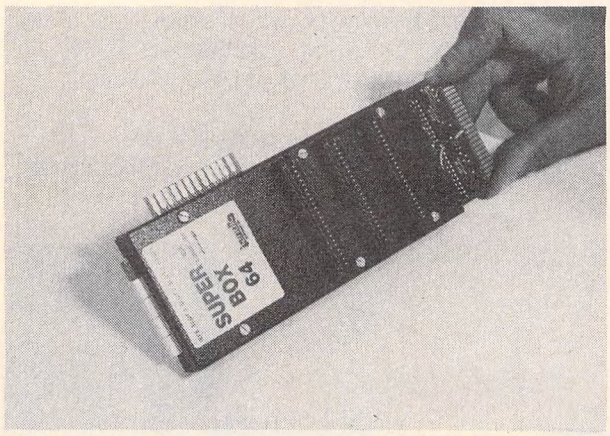
drive's internal No.2 drive select—path is the one used when the drive is to function as DRIVE :0. (Drive select connections in the drive itself have nothing to do with the drive number.) So bend outward one pin for DS1 and DS3. Then replace the shunt block in the socket, taking care that all pins except one pin for the DS1 and DS3 circuits are inserted; that one or more pins have not folded under the shunt block.

If you later decide to add a second drive you must complete the drive select only for drive :1 (which is DS1) on the new drive, and open the MX shunt on all drives. MX means multiplex; If you are using only one drive, it is closed; if you use two or more drives, it is open on drives. Remember, only one drive select is closed on each disk drive.

Doublecheck that the resistor block is installed. All drives should be supplied with one. It is generally located in a DIP socket immediately adjacent to the shunt socket. If you see an empty socket and can't find the resistor block—which looks like an IC, though it might be marked 150 or 22 ohms—look in the shipping carton as it might have been packaged separately (very uncommon, but it happens). If you can't find the resistor block, call the outfit that sold you the drive.

The block is always installed in the first drive, in this instance, drive :0. If you have more than one drive, you must remove the block from all drives except drive :0.

With the disk drive's shunt set and the resistor block installed, all you need is a connecting cable, which consists of two 34-terminal insulation-displacement (press-on) edge card connectors and about five feet of 36-conductor cable ribbon. Why 36 conductor?



THE SUPER BOX *64* is a complete three-cartridge switching system an IEEE I/O for the Comodore *64*.

Because that's the way it's usually sold. Nick the insulation two wires from the edge without the color code and strip off two conductors. Be careful that you don't strip the insulation from a third wire because then you will be short one.

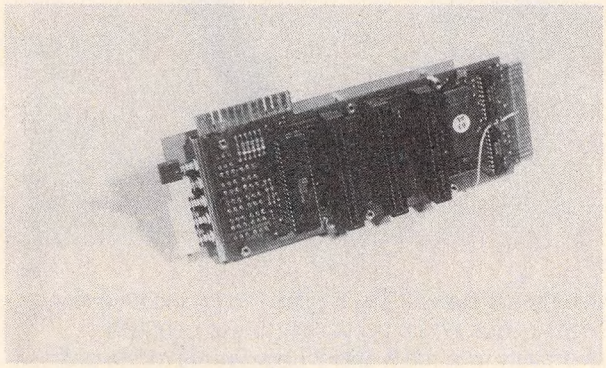
Now you must take extra care to doublecheck everything. Note that only one end of the ribbon cable has a color code—usually red, or one edge and every fifth or tenth wire is color coded. If every conductor is a different color, the cable is probably the wrong stuff. Multi-color wire is a heavier gauge and tends to jam in the connectors—it can cause a lot of grief.

Taking extra care that the color-coded edge connector is opposite the #1 connector terminal, use a vise to squash a connector on each end of the ribbon. Before you squash, triple check that the color-coded conductor is on the side of the connector with the #1

and #2 terminals. The connector end with the #33 and #34 terminals does not get a color-coded conductor. Don't worry about what terminal is which; if you simply get the color-coded wire on the side of the connector marked #1 and #2 the #1 wire is automatically positioned correctly.

Install one connector on the matching disk drive edge connector with the color-coded conductor opposite the #1 terminal on the drive. Some drives have the #1 terminal marked, some don't. It is always the terminal farthest from the power supply plug. If you have the drive vertically mounted in a standard cabinet, the plug is on the bottom and the #1 terminal is towards the top of the drive.

Some disk drives have small holes adjacent to the ribbon connector near terminals #1 and #33. If your drive has the holes (even one), pass an insulated #20 or #22 solid wire through the hole and twist it around



OPEN, THERE'S NOT MUCH TO SEE. A few IC's that do the electronic switching and an AV-6250 for the IEEE I/O.

the connector to make certain it can't pull out. It's not convenient to have to open the cabinet to re-install a connector that's been pulled loose.

Next, protect the ribbon cable against damage where it passes through the cabinet. Allowing for a slight slack, mark where the ribbon will pass through the cabinet and wrap a couple of turns of friction or plastic tape around the cable. Don't overdo the tape.

Finally, make certain the computer's power switch is OFF and plug the controller into the cartridge slot, then plug the disk drive into the back with the color-coded wire towards the back of the computer.

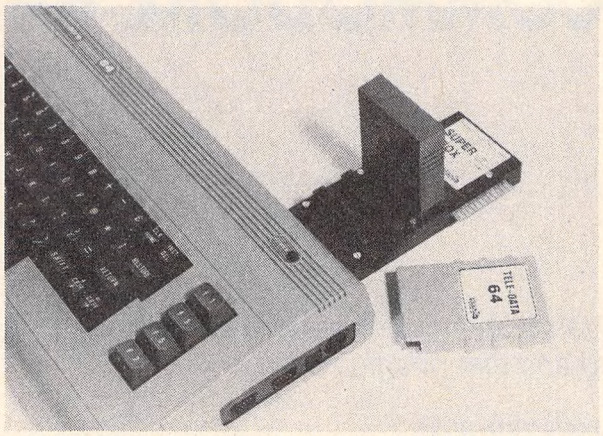
Turn on the power to the disk drive and the computer. You will see the J & M Systems sign-on message indicating it has control of the computer. Play it safe by entering the command RATE 3 on the keyboard. Until you experiment and find out the fastest track access rate for your drive, use 30 milliseconds.

The first thing you will have to do is format a disk so you can save your program and data. The disk initializing command lets you decide whether you want a 35 or 40 track format. To steer you in the right direction, keep these figures in mind:

TRACKSDISK *per disk capacity*
35 (SS) 161K 40 (SS) 184K 40 (DS) 368K (SS = Single-Sided, DS = Double-Sided)

The Super *Box 64*.

The Super Box *64* is one of those devices that you'll wonder how you ever got along without. With more and more Commodore programs going the cartridge route, because the disk system is s-l-o-w, the Super Box *64* takes the effort out of changing programs. Basically, it is a 3-way electronic switch that plugs into the Commodore *64*'s user port, providing three user sockets at the back of the computer. While this is nothing spectacular, the IEEE I/O is.



THE SUPER BOX *64* PLUGS INTO THE USER PORT on the back of the Commodore *64*. The program cartridges are then plugged into any of the three ports on the Super Box. The edge connector sticking out is the IEEE I/O. Mounting feet on the bottom of the unit raises it to the same height as the computer so everything sits flat on the table.

The Super Box 64 is built by Handic, in Sweden, where the best selling computer, as in most of Europe, is the Commodore *64*. So the computer is put to some rather heavy use in schools and even industry, and many scientific devices use the IEEE bus.

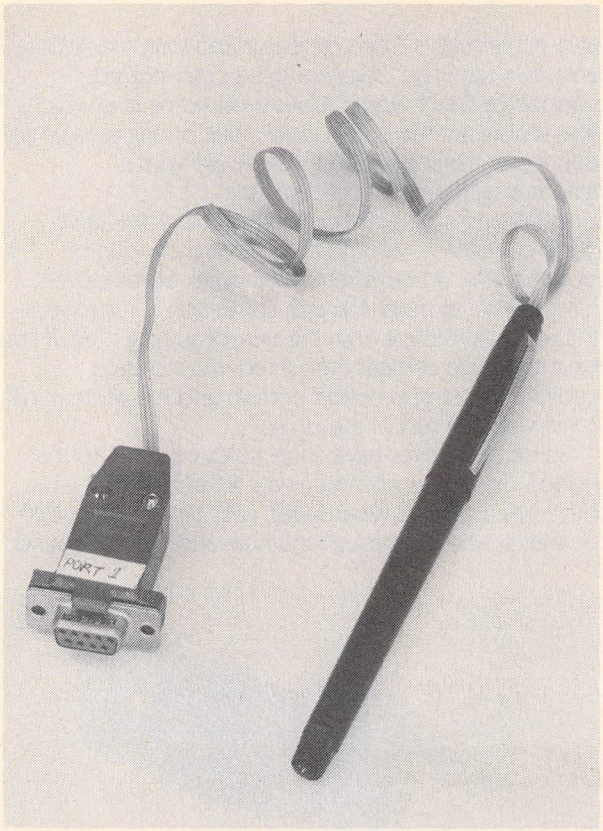
So Handic built an IEEE I/O into the Super Box *64*. It appears as a standard IEEE edge connection sticking out the side of the Super Box. For switches on the back of the device select any of the three cartridge ports, the IEEE I/O, or OFF, meaning the Super Box's ports are switched completely at the output.

Unfortunately, the Commodore *64* must be opened to enable the IEEE bus because one required connection isn't available on the user port. (If you have no need for the IEEE I/O simply plug the device into the *64*'s user port.)

At the front of Super Box is a small cutout in the metal cabinet with a small pin terminal sticking through. Supplied with the device is a wire having a clip lead on one end and a slip-on terminal on the other. Slide the clip lead on the pin terminal. Open the *64*'s cabinet and locate a resistor marked R44. It is almost out in the clear in front of the PROM. Simply apply the clip to the right hand side of the resistor, route the wire out the back of the computer adjacent to the Datssette connector and reassemble the cabinet.

That's all there is to installing the Super Box *64*. Plug in up to three program cartridges and your program is ready at the touch of a button.◀CD▶

BUILD A LIGHT PEN FOR YOUR COMMODORE 64



Here's an inexpensive and easy way to add that "Magic Pencil."

JIM STEPHENS

■What follows is a simple light pen that can be used to demonstrate light pen/computer operations, menu selection and can even be used for simple design drawings with the proper programming.

How light pens operate

In order to fully understand how a light pen works, a few details on how the TV creates the picture are necessary. Once these are understood, the operation of the light pen will seem simple.

The picture on the screen is "painted" by a rapidly moving light beam that starts at the top of the screen and scans line-by-line down to the bottom. The movement is so fast that our eyes cannot see the change. There are 512 lines in the picture and a complete screen picture is painted on the screen many times each second. If the painted area of the screen is to be white, the beam is turned on. if the area is to be black, the beam is turned off. The screen glows when the beam strikes the front of the picture tube. If a fast-acting light sensor such as a simple photo-transistor was placed near the screen, the emitted light would trigger the sensor each time the beam went under it. This is exactly what our light pen will do.

The Commodore *64* creates its own picture information by producing pulses that cause the picture tube beam to scan and turn on and off at the right time. This work is done by a specialized chip in the computer called the "Video Interface Controller" or VIC. The controller constantly reads a selected portion of memory in the computer and converts the data from these locations into readable characters on the screen. More importantly, the controller keeps up with where the beam is located by measuring the time from starting the current line. It does this by incrementing special counters in its circuitry. These counters effectively give the X and Y coordinates of the beam. If these two counters could be read, we could tell where the beam was located at any one instant.

What is needed is a device that would cause the controller to place this information into memory so it could be read out by a special program. This can be accomplished easily using only four components.

Game Port 1 has a pin called A/LP. The LP stands for "Light Pen." If this pin is rapidly switched to ground (negative), the controller will place the contents of its X and Y counters into memory. The X counter data is placed into memory location 53267 and the Y counter data is placed into 53268. If we were to peek these locations as pin 6 of the game port was pulsed, we could see the contents of these locations as they changed from each update. This can be easily done using the following two line program and a joystick plugged into port 1.

```
10 PRINT PEEK (53267), PEEK (53268)
20 GOTO 10
```

Since the fire button is connected to the Light Pen connection of the port, all we need to do is to pulse the fire button to update the memory locations. The contents are printed out each time the program goes through line 10. The fire button does not switch the LP pin clean enough to produce a clear change but you can see the contents change intermittently each time a good pulse is obtained. If a photo-transistor was placed on the screen, and a small switching circuit was

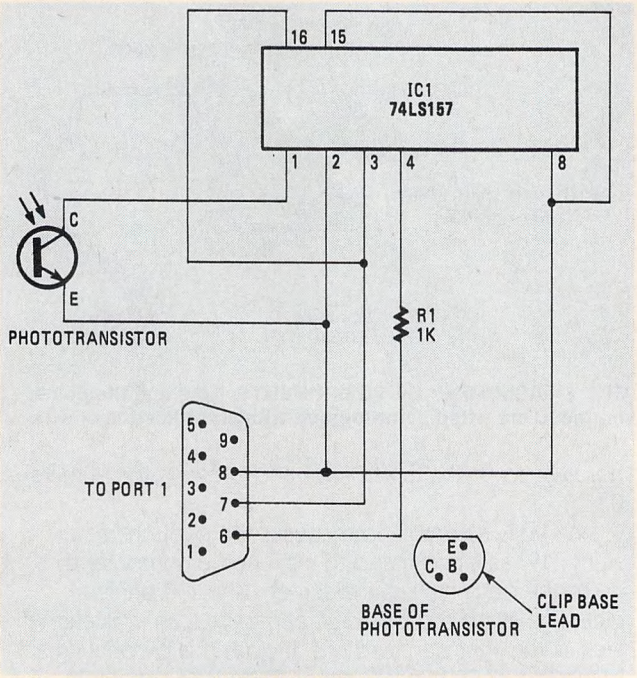


FIG. 1—COMPLETE WIRING DIAGRAM. Only one gate is needed for proper operation.

substituted for the fire button, the numbers would numerically tell us where on the screen the photo-transistor was located.

My major purpose is to demonstrate the operation and construction of a light pen, but the final product can be an extremely useful tool in your programming. Those that are more expert in the field of programming can make this little gadget do all that a far-more expensive pen could do.

The parts count for the project is very low. Only four components are required to make it work. None of the parts cost more than a dollar each.

First, you need a good photo-transistor. Radio Shack sells the FPT 100 type. This is a silicon unit with a built-in lens for light gathering. The switching will be done using a 74LS157 IC. This is an electronic toggle switch that switches the LP pin from high to low and back again each time the photo-transistor detects the light beam on the screen. The 74LS157 can be bought at most any electronic supply house. You'll need a female connector that will connect the three wires to the pins of Port 1. There is also a little 1K ohm resistor which is needed, but it is only used so that the keyboard will work correctly when the joystick is plugged in.

If you have a solderless breadboard, this would be a good time to use it to test the circuit before making the complete pen. However, there are so few connections, most pens work on the first try.

Construction.

You will need a plastic felt-tip pen with a cap that snaps over the pointed end. These usually have plastic plugs in the end opposite the felt tip. Proceed as follows to construct the light pen body.

The cap of the felt pen snaps on to cover the tip. This is usually the result of either small nibs on the barrel or an indentation. Remove the cap and saw off the end of the pen right above the nibs. Leaving the nibs will allow the cap to be snapped back on. Remove the plastic plug on the other end of the pen and push out the wick that holds the ink. Throw the felt tip piece away and wash the remaining parts.

Next, take the 74LS157 IC and clip all of the leads down close to the IC chip. Leave about an eighth of an inch of lead on the IC. See Fig. 1. With the leads shortened, the IC should readily slide into the pen's cap. If so, you are ready to work on the pen barrel. If the IC seems too large for the pen's cap, you'll need a larger felt tip pen. Again, Fig. 2 shows how the circuit will be inserted.

The photo-transistor comes with three leads. The base or B lead will need to be clipped off. Figure 1 has a bottom view of the transistor that will help in identifying which lead to clip.

Make the hole in the end of the barrel of the pen big enough to insert the photo-transistor. If, after removing the plastic plug, the hole is too large, you can wrap the transistor with tape later when you insert it permanently into the pen housing.

Solder two different color light-gauge wires to the two leads coming from the photo-transistor. Make a note on which of the colors goes to the collector or C lead and which goes to the E or emitter. These wires should be flexible and slightly longer than the barrel of the pen. The solder joints at the transistor should be wrapped with one turn of masking tape to keep them from shorting together. Thread these two wires through the end of the barrel as shown in figure 2.

PARTS LIST

R1—1000 ohm, ⅛-watt resistor
IC1—74LS157 two-to-one line multiplexer
Phototransistor—FPT 100
9-Pin subminiature female connector, 24-inch ribbon cable, Felt-tip pen body (see text).

Drill a small hole into the end of the pen's cap and insert three wires that are about 24-inches long. These should be flexible, insulated and multi-strand types. I used three color coded wires which were from a piece of ribbon cable. Pull about three inches of the wires through the cap and tie a knot in these to create a strain relief. Don't pull the knot back into the cap until ready to assemble the complete pen.

Make sure you have a good pencil-type soldering iron rated at 25 watts. Large soldering irons could over-heat the pins of the IC since we are going to be soldering directly to them.

Using the connection diagram in figure 1 and small lengths of insulated wire, solder the inter-connections on the 74LS157. Use as little solder as possible and do not over-heat the pin. Notice that pins 2, 8 and 15 are all connected together. Pins 3 and 16 also connect together. The 1K ohm resistor can be placed flat on top of the IC and one of its leads can be soldered directly to pin number 4. The diagram in figure 1 shows the

74LS157 as it would appear from the top with its leads pointing down. Notice that a notch in the IC marks the end on which pin one is found. Some IC's may not have the notch but a small dot placed over pin 1.

The C or collector lead wire from the photo-transistor connects to pin 1 of the IC and the E or emitter lead connects to pin 2. Be careful not to un-solder the connection made to this pin earlier. One of the colored wires coming through the cap is soldered to pin 2, 8 or 15 also. One of the other colored leads solders to pin 3 and the remaining wire solders to the unused end of the 1K resistor.

Now solder the 24 inch-long wires to the female joystick socket. This socket is sold by Radio Shack and other outlets. The parts list gives the Radio Shack part number. Figure 1 shows the rear of the connector that receives the wires. This view is as though it were plugged into the joystick port and you were looking at it. The pins are numbered along the bottom as 6,7,8, and 9. We will be using pins 6 through 8 only.

The wire from the 1K resistor solders to pin 6 of the socket.This is the Light Pen connection. It is a good idea to get some small lengths of 1/8th-inch heat-shrink tubing to fit on these connections since they are very closely spaced. The wire coming from pin 3 of the IC is the positive power connection and it goes to pin 7 of the socket since this is the plus or positive connection of the computer power supply. The remaining wire comes from the ground connection of the IC at pin 8 and goes to pin 8 of the socket.

After you are sure all connections are correct and with the computer off, you can plug the connector into port 1. Now turn on the computer. The 64 Ram System message should come up within two seconds. If not, turn the 64 off and unplug the socket. Recheck all of the wiring, especially the power connections.

If the System notice comes up as it should, but the cursor is moving across the screen on its own, then turn the computer off since the LP pin is getting a negative voltage when it should be positive. Again, recheck the wiring using figure 1. Double check that the correct leads from the photo-transistor are going to the correct pins on the IC. Unless you used a blow-torch on the IC and it doesn't look like it's half-melted, the IC is probably OK. However, if you connected the leads going to pins 7 and 8 on the socket backward, this can ruin the IC if left on for more than 2 or 3 seconds. If the cursor remains at the first location on the screen, you are ready to test the circuit using software.

Testing the Light Pen.

Listing 1 is a test of the light pen's response to the screen. This short routine lets you set the intensity of the monitor or TV in order to obtain the best response from the light pen. Line 30 is entered simply as a print command and the control key is held down as the numeral 2 key is pressed. This changes the character color to bright white. Line 50 is entered also by a print command that prints while lines (reverse spaces) on the screen 24 times. This is done by first holding down the Control key and pressing numeral 9 key. Then space over 39 spaces and turn off the reverse print by

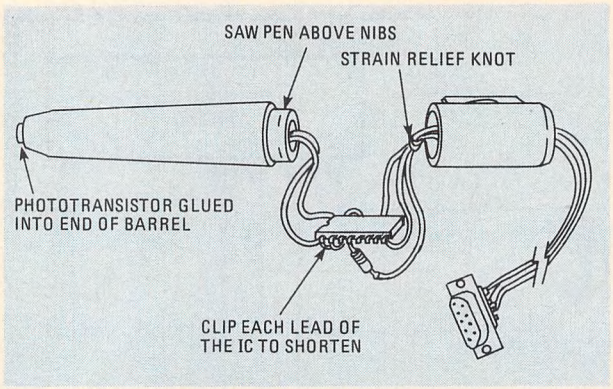


FIG. 2—ASSEMBLY OF COMPONENTS. Note that the points on the IC are wired point-to-point with short lengths of wire.

holding down the control key and pressing the numeral 0.

Line 90 is a command that uses the print character string (19) as a command to instruct the computer to go to the beginning of the screen. Line 100 prints a clear line at the top of the screen to give an indication area of the light pen readings. It does this by printing a blank area of 20 regular spaces. Type in the program listing and save it. With the pen plugged in, run the program. The screen will turn bright white with a dark border. Look at the column and line numbers at the top of the screen. These are the numbers placed in the memory registers when the system was turned on. Place the photo-transistor near the screen and these numbers will start to change as the pen is moved around. If they do not change, turn up the brightness or intensity of the screen. If the numbers still don't respond, check your typing of the program. If it looks OK, turn the computer off and recheck your wiring. Some black and white sets have a shaded plastic cover over the picture tube. This may have to be removed before enough brightness can be obtained.

Most likely the pen will work correctly. But, if the numbers are changing before the pen is placed near the screen, then the pen may be picking up light from the room and the photo-transistor will need to be placed deeper into the pen's tip for shielding.

LISTING 1 - Short routine by which to test the operation of the light pen. The intensity of the screen can be properly set using this program.

```
 10 REM SCREEN INTENSITY TEST
 15 REM LIGHT PEN TEST
 20 REM JIM STEPHENS-NASHVILLE, TN.
 25 REM C=COLUMN L=LINE
 30 PRINT" [CONTROL 2]"
 40 FOR N = 1 TO 24
 50 PRINT " [RVS ON] [39 SPACES] [RVS OFF]"
 60 NEXT N
 65 PRINT" "TAB(12)"INTENSITY TEST"
 70 C=PEEK (53267)
 80 L=PEEK (53268)
 90 PRINT CHR$(19);"C=";C;TAB(10)"L=";L
100 PRINT CHR$(19); "[20 SPACES]"
110 GOTO 70
```

Place the tip of the photo-transistor near the middle of the screen. Notice that the numbers remain within a small range even though they are still changing. Notice too, that the column number changes much more than the line number. This is normal and the program will take this into account by looking for ranges rather than a specific column or line numbers. If the numbers start changing before the pen touches the screen, turn the brightness down.

Place the pen in the top left corner of the white area and the column number should be in a range of around 30 to 40. The line number will be around 55-60. Moving the light pen down increases the line numbers and moving the pen to the right increases the column numbers. When the pen is in the bottom right-hand corner of the white area, the column and line numbers should be around 230. If this test is successful then slip the IC and wires into the pen cap and snap the cap and barrel together. The light pen is now complete. You may also improve the socket by adding the socket shroud on the plug.

Make the Light Pen Useful.

If the Light Pen responded correctly to the intensity test shown in Listing 1, then type in the small demo program in Listing 2 and save it. Enter RUN and the screen will clear and present you with four options. These options could have been most any menu but I chose fruit since my mind has turned to mud and I couldn't think of anything clever. This short program shows the ability of the light pen to sense where it is on the screen. By placing a white square in various areas on the screen with an explanation by each, the computer will respond according to the area at which the screen command is located. For example, you might place the square in the lower left and write "sound" by it. If the computer sensed the pen in that area, it would go to a sound producing routine. In Listing 2, four choices are provided. Apple, Pear, Orange, and a comand to clear the whole screen. When the pen is placed over the appropriate square, the computer responds as though it saw where the pen was placed. It does this as follows:

Line 25 is a print command. By holding down the CONTROL key and pressing the numeral 2, the screen color is changed to bright white again. This makes the light brighter for the sensor. Line 30 is a FOR NEXT loop that prints the character string 17 twenty-two times. CHR$(17) means to move the cursor down one line. This has the same effect as clearing the whole screen. Line 70 tells the computer to go to the beginning of the screen by using the print command and a CHR$ (19). Then, by printing one "CURSOR DOWN" the cursor will drop down one line on the screen. Lines 90 through 120 print the white squares and the words by each. This is done in line 90 by first printing one Cursor Down (CURS DWN) which means typing your first quote sign and then pressing the cursor down arrow. The result as in line 70, is a reversed Q. You then tab over to column 20 and place a white square. The white square is done by again printing a "reverse on (RVS ON) which is written by holding the CONTROL key and pressing the

LISTING 2 - This program shows what can be done with the light pen. This same prodecure could be used for many other purposes.

```
  5 REM LIGHT PEN DEMO
 10 REM BY JIM STEPHENS - NASHVILLE, TN.
 15 B=0
 20 C=0
 25 PRINT "[CONTROL 2]"
 30 FORN=1TO22:PRINTCHR$(17):NEXTN
 40 LETA$= "APPLE"
 50 LETB$= "PEAR"
 60 LETC$= "ORANGE"
 70 PRINT CHR$(19); "[CURS DWN]"
 80 PRINT " CHOOSE YOUR FAVORITE FRUIT"
 90 PRINT "[CURS DWN] TAB(20)"ON][5 SPACES]
    [RVSOFF]"A$; "[3 CURS DWN]"
100 PRINT "[CURS DWN] TAB(20)"[RVSON]
    [5 SPACES][RVSOFF]"B$;"[3 CURS DWN]"
110 PRINT "[CURS DWN]" TAB(20)"[RVSON]
    [5 SPACES][RVSOFF]"C$;"[3 CURS DWN]"
120 PRINT "[CURS DWN]" TAB(20)
    "[RVSON][5 SPACES][RVSOFF] CLEAR
    SCREEN"
130 Y=PEEK (53268):C=C+1:IF C=1 THEN B=Y
140 IF B=Y THEN GOTO 130
150 IF Y> 190 AND Y< 210 THEN GOTO 10
160 IF Y> 70 AND Y< 90 THEN 220
170 IF Y> 110 AND Y< 130 THEN GOTO 230
180 IF Y> 190 AND Y< 210 THEN GOTO 10
190 B=Y
200 PRINTCHR$ (19); "YOU CHOSE THE";C$
210 GOTO 130
220 PRINTCHR$(19); "YOU WANT THE"
    A$:B=Y:GOTO 130
230 PRINTCHR$(19); "SO YOU WANT A";B$: B=Y:
    GOTO 130
240 B=Y
250 GOTO 130
```

Numeral 9. You enter spaces (which are now white) then again hold the CONTROL Key and press the numeral 0 key for a reverse off (RVS OFF). The word "APPLE" is printed in response to the A$ and then three cursor downs are printed inside the quotes to make the cursor drop on the screen 3 lines. This is repeated in lines 100 through 120 to place the white squares and words in the appropriate places.

Lines 200 through 230 are the routines to which the program jumps when it has read the value of the light pen registers. The printing of the CHR$ (19) simply tells the computer to print on the first line of the screen.

Place the pen on your choice and watch the response of the computer at the top of the screen. Lines 150 to 180 of the program checks the range of the line coordinate and lines 200 to 230 prints the appropriate responses. The "clear screen" option was included to demonstrate that most any operation can be executed by just a touch of the screen.

Summary

The light pen shown here is not as exact as those $200 units. Neither are much good without the proper programming however. I think that this small inexpensive unit can be made to be more exact and more useful by good software routines. ◀CD▶

SOFTWARE REVIEW

SmartKey II Plus (IBM version tested)

■SmartKey II Plus is a key definition program for CP/M and PC/MS-DOS compatible computers that positions itself between the keyboard and the computer's input buffer. It intercepts keystrokes so the user can redefine one or more before sending them on to the computer or the applications program. A user-defined keystroke can represent just one or up to 30,000 characters, the precise limitation depending on available user RAM or how much RAM the user decides to reserve for key definitions. (Key definition is a synonym for what is commonly called a macro.) For example, BASIC programmers can swap the ";" and ":" symbols so that the more commonly used ":" is unshifted while ";" becomes the shifted symbol. By the same definition procedure, the Alternate-H keys might be redefined to provide a complete letter heading, or even a form letter to be called up by simply touching two keys.

Almost every key, and all their Alternate, Control and Shifted values can be redefined. Also, Smartkey II Plus has its own SuperShift key—usually the tilde (~), but which can be user-selected—so that no desired redefinition will conflict with an application program's use of the same key or combination of keys. One popular key redefining program uses virtually every combination of the A, B and C characters for internal use, preventing a definition of the keys so that Alternate-A means DIR A:, Alternate-B means DIR B.

The power

The real power of SmartKey II Plus is an on-screen window that breaks into the normal screen display of the application program and shows everything going on with SmartKey II Plus independent of the applications program. The window permits the user to: define a key at any time without disturbing the program; record keystrokes for use at a later time; check a key's definition at any time without disturbing the program: correct a definition; and nest definitions.

When the definition is called, the word DATE would be automatically entered on the screen, and then the computer would wait for the date to be entered from the keyboard. The <RETURN> following the keyboard entry would resume insertion of the definition: CUSTOMER No. would be inserted and the definition would again pause for keyboard entry of the customer's reference number: The <RETURN> following the keyboard entry would resume the inventory program.

Actual programming of the definition can be done on-the-fly by simply touching what is called the SmartKey—the ". If" is touched once SmartKey II Plus breaks away from the applications program and displays its window. After the definition(s) is entered, touching the SmartKey a second time programs the definition into a key and returns control to the application program or the disk operating system. If the actual " key is required for the program the user simply touches it twice in rapid succession, which causes conventional entry of the symbol. If the " is commonly required for your own programs or word processor, you can reconfigure SmartKey II Plus to use a different symbol for the SmartKey.

One unusual strength of SmarKey II Plus is that definitions can be programmed in ASCII—decimal or HEX—which permits the IBM PC's international, math and Greek characters to be available as a single keystroke that feeds both the screen and the printer. For example, the infinity symbol (ASCII 236) is not available directly as a key, nor is the Omega symbol (ASCII 234) which represents resistance to electronic technicians, but by using SmartKey II Plus you could put infinity on, perhaps, the Alternate-I key, and Omega on the Alternate-0 key. However, ASCII definitions were possible only through definition files created with a word processor, although the manual sort of implies it's possible to do on-the-fly. (It is not really made clear.)

SmartKey II Plus is supplied with a program called SmartPrint II Plus which also is transparent to the application program, only this time the program is positioned between the application program and the printer. SmartPrint II Plus automatically allows use of most conventional matrix printer functions such as wide, emphasized and condensed printing, as well as super and sub scripts. Unlike SmartKey II Plus, SmartPrint II Plus cannot be programmed on-the-fly because it is really a translation program, and a translation/definition file for your particular printer must be created, or you can use one of the supplied printer definition files. However, again the defintions can be created directly on the screen in a window and then saved as a file. Alternately, you can create the definition file with a word processor, but once again it's easier using SmartPrint II Plus' window.

SmartPrint II Plus commands can be imbedded in almost any kind of applications program—word processing, data base, spreadsheet, whatever. The printer command is anything following the reverse slash ("\"), as the control key. For example, \w turns wide print off. In the line "This is \Wwide\w type," the word wide would be printed in large type.

While SmartKey II Plus and SmartPrint II Plus can be loaded before or after an applications program, some RAMdisk software hangs the computer if SmartKey II Plus is loaded before the RAMdisk driver. If this happens to you, simply rewrite your AUTOEXEC.BAT file so the RAMdisk is loaded before SmartKey II Plus.

Otherwise, both programs proved reliable and superb performers, both being notably easy to use. SmartKey II Plus (Includes SmartPrint II Plus), Software Research Technologies, Inc. Suite 211, 3757 Wilshire B'lvd., Los Angeles, CA 90010.◀Φ▶